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ICTs and Project-Based Learning (PBL) in EFL: Pre-service Teachers' Attitudes and Digital Skills

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ABSTRACT

Although there is a rich body of literature about the implementation of ICTs in foreign language learning, none has investigated the technological attitudes and digital skills of pre-service teachers thanks to the adoption of a Project-Based Learning (PBL) methodology. This study analyses the attitudes and digital skills of pre-service teachers through the implementation of ICT-based projects in the EFL classroom. For this purpose, 120 teacher candidates at the University of Alicante (Spain) participated in this experiment. First, all students were administered a pretest to measure the degree of technological affinity and digital skills. Then, they were divided into smaller groups (cooperative learning) in order to design and create several ICT-based projects aimed at teaching English as a foreign language to children and young learners. All the participants later presented their projects and evaluated the results (peer-evaluation) from a technical and pedagogical perspective. Finally, they completed a post-test based on their self-perceived learning outcomes in relation to ICT integration. The results revealed significant learning gains in digital and higher-order thinking skills (create, analyse, evaluate). Teaching candidates show a positive attitude towards the integration of ICTs in the EFL classroom but demand better training as regards the adoption of new technologies, particularly given the current situation and the need for increased on-line teaching.

Key words: EFL, ICTs, PBL, Attitudes, Digital Skills

INTRODUCTION

The implementation of ICTs in foreign language learning has been the object of study in several publications over the last years thanks to the constant emergence of web-based programs, serious video games and mobile applications (Zhao, 2013; Anas & Musdariah, 2018; Ngo & Eichelberger, 2019). The widespread use of smartphones and the growing number of educational apps have brought about significant changes in this field (Godwin-Jones, 2011; Traxler & Kukulska-Hulme, 2015; Wrigglesworth, 2019). While some of these articles examined the benefits of using ICTs in the language classroom, particularly as regards student motivation (Kenning, 2007; Men & Noordin, 2019), others analysed the integration from the in-service teachers' perspective (Nim Park & Son, 2009; Yang, 2019) but little research has comparatively focused on the technological and teaching skills of digital native students as future instructors (Hong 2010; Schmid & Hegelheimer, 2014; Yet and Noordin, 2017; Guillén-Gámez et al., 2019).

The adoption of a Project-Based Learning (PBL) methodology where technology plays an important role has been the research subject in different articles (Poonpon, 2017; Artini et al., 2018; Tseng & Yeh, 2019). Project learning allegedly dates back to the early 1900s, when William Kilpatrick (1918) first used this term, which was later redefined as Project-Based Learning. PBL is also short for Problem-Based Learning, a teaching pedagogy originated a few decades later in the 1960s, which some authors consider a subset of project-based learning, while others believe them to be two different methodologies (de Graaff & Kolmos, 2007). Roessingh and Chambers (2011) explained and illustrated some of the guiding principles of PBL, such as the explicit teaching and learning objectives, authentic and engaging learning tasks, mediated and integrated instruction, promotion of higher-order thinking skills, continuous assessment and monitoring of the learning process.

The implementation of a PBL methodology based on ICTs has been discussed in Education. Gülseçen and Kubat (2006) analysed some differential effects of PBL versus a conventional teacher-focused instruction on a group of cognitive and affective variables among teaching candidates. They concluded that students from the departments of Education and Foreign Language Teaching considered PBL as an effective learning tool, rich in motivation. Similarly, Ochoa et al. (2015) explored how students benefitted from using ICTs in the thinking processes involved in PBL. However, other authors delved into the limitations related with the use of ICTs

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in the classroom. For example, So and Kim (2009) identified different conflicts among students in translating pedagogical content knowledge into designing technology integrated lessons, while Marwan (2015) pinpointed a number of obstacles to the integration of ICTs in an ESL context, such as lower pedagogical understanding and preparation.

Consequently, there is a need to investigate the attitudes and digital skills of teacher candidates through the adoption of a Project-Based Learning (PBL) methodology in the EFL classroom. This research focuses on the effects of implementing a PBL methodology using ICTs and the technological and pedagogical preparation of future English instructors in their transition from digital native students to digital native teachers. The adoption of a PBL methodology promotes functional and critical thinking skills among students in a learner-focused environment in which the instructors play the role of facilitators and co-learners.

RESEARCH METHOD

Objectives

This article investigates students' attitudes towards ICTs and their self-perceived digital and pedagogical skills in the EFL classroom. The independent variable was the adoption of a PBL methodology, and the two dependent variables were the students' technological attitudes and digital skills. The first objective was analysing the impact this methodology may have on students' technological confidence, reliability and interest; the second objective was to investigate students' self-perceived competence and learning outcomes before and after the treatment.

Participants and Context

Research participants were Education students enrolled in the *Integrating skills in English* class at the University of Alicante (Spain). This is a three-month, intermediate English subject taught on a daily basis in order to prepare students to become teachers of English in Elementary and Secondary Education. The main goal is to help teaching candidates transition from digital native students to digital native teachers and to train them in the meaningful integration of ICTs into the EFL classroom. A total of 120 undergraduate students (83% of those were female, while 17% were male) participated in this research and they completed a pretest, a posttest and five ICT-based projects.

Instruments

Quantitative and qualitative data was obtained through different research instruments:

1. A pretest including four different sections was administered during the first week of class. The first section on technological affinity included 5 questions related to technology use, such as the number of computers owned or the main reasons for using smartphones and PCs. The second section contained 3 questions related to different pedagogical principles, partly based on Bloom's taxonomy (1956). The third section incorporated a question with 11 items aimed at measuring student attitudes towards ICTs. Finally, the last section encompassed 14 items about students' self-perceived digital skills. Questions included in the last two sections were partly adapted from previous research by Jing Lei about pre-service teachers (2009).
2. A post-test replicating all sections except the first one was administered during the last week of class to compare the initial versus final results.
3. Class debates and presentations. Qualitative data was obtained through class observation and peer-evaluation. Students needed to present and explain their ICT-based projects in the classroom, which were later assessed following a rubric including different technological and pedagogical aspects. Thus, project members discussed the advantages and limitations of the digital tools they used and their learning outcomes.

Procedure

Students worked co-operatively in and outside the classroom in order to create five ICT-based projects aimed at teaching English to children and young learners. For this purpose, participants were required to take their own digital devices (laptops, tablets, smartphones) to the classroom in line with other experiments based on a BYOD strategy (Burston, 2016; Chou et al., 2017). In their projects, students were divided into teams of five to six members and completed different tasks following the instructions provided in the class handbook. Team members were free to select their target pupils in each project and choose the topic, web-based program or application depending on their own needs. Each ICT-based project was dedicated to a specific lesson, and the handbook contained key information on every project such as language and content learning objectives, keywords, itemized design procedure, scaffolded activities and recommended ICTs.

The rubric used in each project was designed for the assessment of different technical and pedagogical aspects such as originality, overall design, vocabulary or content suitability to the target students. In line with previous studies (Hung, 2017; Rudolph, 2018), a project assessment was conducted in the classroom using three mobile apps (Mentimeter, Kahoot and Poll Everywhere); these clickers were used to conduct live polls and enable peer instruction (peer-evaluation), have instant feedback and interact with the class in real time by sharing their comments and results (cooperative learning), while getting students involved in their own assessment (self-assessment). Participants covered a wide range of topics and activities related to EFL in their projects, such as the samples shown in Figure 1.

FINDINGS AND DISCUSSION

Participants' Technological Affinity

The pretest results revealed that every student had a smartphone and that most of them owned a laptop and a PC.

Over half of the students indicated that they started using a computer during their secondary education (12-16 years), while nearly the other half stated it was during their time in elementary school (6-12 years). Regarding the time spent daily on a computer, the results were divided between those who marked 1 to 3 hours and those who stated 3 hours or more. As for the main reasons to use a computer, most of the students selected academic purposes, closely followed by navigating the web. Nearly two out of three respondents chose entertainment, excluding games, such as watching movies, videos or listening to music, and a similar percentage indicated on-line shopping, followed by communication and social networking. The pretest also included some items related with the use of mobile phones, since nowadays smartphones outnumber PCs and laptops in the classroom, and these electronic devices were particularly helpful in the early and late stages of the projects dedicated to searching web-based information and peer-evaluation. Additionally, students made use of smartphones as an IM (instant messaging) tool outside the classroom by creating different chat groups to share their learning progress.

Participants' Knowledge on PBL and Thinking Skills

The first item in the second section of the pretest was an open-ended question where students had to explain the meaning of Project-Based Learning (PBL) by using their own words. Three grading options were possible depending on whether their answers were considered correct, incorrect or unclear: 38.15% students provided an appropriate definition of PBL, 53.38% of the answers were incorrect or unclear, while 8.47% did not know the meaning of it as the examples shown in Table 1.

As previously explained, the post-test administered at the end of the course replicated the last three sections of the pretest. First, students were asked to select the most relevant thinking skills from a cognitive approach following Bloom's taxonomy. In line with previous studies (Anderson, 2001; Fadul, 2009; Van Voorhis, & Paris, 2019), all cognitive levels were explained and described as parallel, complementary and interconnected rather than isolated or exclusive. This question intended to measure the importance given by students to each level both at the beginning and at the end of the experiment. As shown in Figure 2, over 61% of students rated understanding the most important skill in the pretest, followed by creating

Figure 1. ICT-based projects created in the EFL classroom
(From top left to bottom right: digital mind map, interactive poster, digital storytelling and AR-based lesson)

Table 1. Definition of PBL provided by pre-service teachers. Q: Explain PBL in your own words

Type	Answer samples
Correct	ID20: Learning is achieved through the elaboration of a project composed of intermediate tasks by students using different skills. ID78: This methodology requires a higher involvement of students since they are protagonists of their own learning. It is based on meaningful tasks and collaborative work ID103: PBL consists in solving a problem or challenge by grouping students in cooperative work teams in which each member takes a responsibility as a member of the group. The teacher acts as a guide.
Incorrect / unclear	ID7: Learn through communication, using the language to learn ID54: I am not sure, to learn doing something ID81: include a communicative approach in the learning process.
Not known	ID1: No ID76: I don't know what it means

and applying, but the results of the post-test differed after sharing the class projects. The significance of understanding slightly decreased in the post-test, while the result for creating was higher. Interestingly, the difference for evaluating and analysing between the pretest and the post-test was very small.

Participants' Self-perceived Language and Technological Competence

The post-test replicated two general questions related to student self-perception of their overall language and technological competences. Participants were first asked if they thought they had the necessary language competence to teach an English class to children and young learners. They were later asked whether they thought they knew how to integrate ICTs effectively into the EFL classroom. The answers based on a 5-point Likert scale ranged from 1 (strongly disagree) to 5 (strongly agree). The results shown in Table 2 revealed a sharp increase in the number of participants who agreed on the improvement of their self-perceived language skills, from 30.1% in the pretest to 42.6% in the post-test, as well as on their digital skills, from 37.5% to 46.7%. Therefore, students perceived their English language level was higher after the treatment and believed they knew how to better incorporate different digital tools and game-based apps into the English classroom at the end of the course.

Participants' Attitudes Towards ICTs in the EFL Classroom

The third section about students' technological attitudes was partly based on Jing Lei's scale (2009) and was aimed at measuring different digital skills. Table 3 displays the compared means and standard deviation for each of the 11 items included in the pretest and post-test. While participants initially took a more neutral view on several items (AT1, AT3, AT4) in relation to the reliability of computers in general, the results showed more positive scores at the end of the course. Similarly, their academic interest (AT6, AT7, AT8, AT9) and self-reliance (AT10, AT11) in ICTS as teaching and learning tools increased from moderate results in the pretest to higher scores in the post-test. It may be worth noting that the result for item 5 (AT5) about the isolating effects computers may have on students was slightly more neutral in the post-test. While participants' academic interest in learning about ICTs clearly increased at the end of the course, they did not believe that a more frequent use of technology would necessarily lead to higher respect among peers.

The Wilcoxon signed-rank test was used to correlate the results as shown in Table 4. This non-parametric test was employed to compare mean ranks based on ordinal data, and it indicated statistically significant differences in all items except number 2 ($Z = 1.275$, $p = 0.202$) and number 5 ($Z = 1.428$, $p = 0.153$). As previously noted, no significant changes were observed among participants regarding the correlation between frequency of use of ICTs and peer respect (AT2) and the isolating factor of ICTs (AT5) at the end of the course.

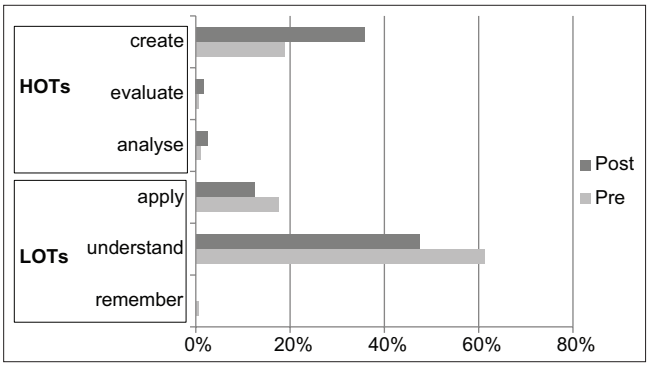

Figure 2. Pre-service teachers' perception of LOTs and HOTs

Participants' Digital Skills in the EFL Classroom

The last section of the post-test considered the students' self-perceived digital skills. As shown in Table 5, participants rated highly their initial competence in skills such as navigating the web (DS1), finding information (DS2) or using word processors (DS10). Thus, the results of those items remained very similar in the end. Other items with more moderate scores in the pretest such as evaluating information (DS3), searching on-line databases (DS4), using web-based programs (DS5) or image and video editing (DS9) revealed a small increase in the post-test. The most significant differences were observed in the items related with using apps to teach/learn English (DS6), using apps for Education in general (DS7) and creating a blog in English (DS8).

The results of the last two items in the survey associated with using ICTs to help children with special needs (DS13) and using different ICTs depending on the students' needs and context (DS14) showed no significant gains. The item

Table 2. Self-perceived English language and technological competence. N = 120.
1 = Strongly disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly agree

	1		2		3		4		5	
	Pr	**Po**	**Pr**	**Po**	**Pr**	**Po**	**Pr**	**Po**	**Pr**	**Po**
Language competence	7.4	0.8	27.3	20.8	35.2	35.8	21.6	30.8	8.5	11.8
Technological competence	3.4	1.7	24.4	13.3	34.7	38.3	29	39.2	8.5	7.5

	Mean		**Std. Deviation**	
	Pre	**Post**	**Pre**	**Post**
I have the necessary language competence	2.94	3.32	.998	.961
I have the necessary digital competence	2.98	3.38	.993	.870

Table 3. Attitudes (AT) towards ICTs. N = 120. Cronbach's α=.858.
1 = Strongly disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly agree

m	Mean		Std. Deviation	
	Pre	Post	Pre	Post
AT1 Computers are generally reliable.	3.45	4.03	1.085	1.000
AT2 The more technology you use, the more respect you will get from your peers.	2.53	2.33	1.396	1.024
AT3 I feel comfortable using technology.	3.45	4.02	1.258	.926
AT4 I do well with computer technologies.	3.29	3.89	1.154	.915
AT5 Computers and related technologies will isolate students from one another.	2.97	2.64	1.123	1.019
AT6 I am interested in computers and ICTs.	3.71	4.32	1.409	1.045
AT7 I am interested in ICTs that will help my teaching in the future.	3.67	4.43	1.700	1.098
AT8 I believe that ICTs can help me teach better.	3.56	4.13	1.547	1.081
AT9 I believe that ICTs can help my students learn better.	3.50	4	1.364	1.085
AT10 I am confident in using ICTs in my learning.	3.40	4.09	1.191	.979
AT11 I am confident in using ICTs to teach.	3.49	4.08	1.248	1.070

Table 4. Wilcoxon signed-rank test results on students' technological attitudes (AT)

	AT1Po – AT1Pr	AT2Po – AT2Pr	AT3Po – AT3Pr	AT4Po – AT4Pr	AT5Po – AT5Pr	AT6Po – AT6Pr	AT7Po – AT7Pr	AT8Po – AT8Pr	AT9Po – AT9Pr	AT10Po – AT10Pr	AT11Po – AT11Pr
Z	-4.061[b]	-1.275[c]	-4.268[b]	-4.402[b]	-1.428[c]	-4.220[b]	-4.286[b]	-3.712[b]	-3.951[b]	-4.926[b]	-4.367[b]
Asymp. Sig. (2-tailed)	.000	.202	.000	.000	.153	.000	.000	.000	.000	.000	.000

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks
c. Based on positive ranks

Table 5. Self-perceived competence in digital skills N = 120. Cronbach's α= .856
1 = no experience 2 = beginners (little skill) 3 = moderate or average knowledge
4 = substantial expertise (can perform the task on my own and customize it)
5 = experts (can teach others how to use, create and customize it)

Item	Mean		Std. Deviation	
	Pre	Post	Pre	Post
DS1 Navigate the web.	4.10	4.18	.760	.682
DS2 Finding information from web searches.	4.01	4.15	.667	.630
DS3 Evaluating information from web searches.	3.65	3.82	.710	.756
DS4 Search online databases for academic information (articles, books, etc.).	3.38	3.52	.810	.778
DS5 Using web-based programs to teach/learn in English.	3.57	3.79	.862	.732
DS6 Using apps to teach/learn English.	3.38	3.82	.871	.756
DS7 Using apps for Education in general.	3.16	3.44	.887	.828
DS8 Creating a blog in English.	3.45	4.01	.908	.761
DS9 Downloading and editing pictures and movies for the English class.	3.42	3.78	.955	.900
DS10 Using word processors for the English class.	4.15	4.38	.948	.769
DS11 Creating and analysing surveys.	2.89	3.94	1.123	.792
DS12 Using and playing video games for the English class.	3.13	3.28	1.040	1.117
DS13 Using ICTs to help children with special needs in the English class.	2.87	2.91	.982	1.061
DS14 Use different ICTs depending on student needs and context.	3.17	3.23	.846	.921

about video games (DS12) evidenced similar scores in the pretest and the post-test, although participants needed to analyse and discuss the benefits of using educational video games in the EFL classroom.

The Wilcoxon signed rank test shown in Table 6 revealed that the observed difference between both measurements, the pretest and post-test, was statistically significant in 7 out of the 14 items related with students' digital skills. Therefore,

Table 6. Wilcoxon signed-rank test on students' Digital Skills (DS)

	DSPo1 - DSPr1	DSPo2 - DSPr2	DSPo3 - DSPr3	DSPo4 - DSPr4	DSPo5 - DSPr5	DSPo6 - DSPr6	DSPo7 - DSPr7
	-.851[b]	-1.930[b]	-2.072[b]	-1.549[b]	-2.092[b]	-4.098[b]	-2.268[b]
	.395	.054	.038	.121	.036	.000	.023
	DSPo8 – DSPr8	**DSPo9 – DSPr9**	**DSPo10 - DSPr10**	**DSPo11 - DSPr11**	**DSPo12 - DSPr12**	**DSPo13 - DSPr13**	**DSPo14 – DSPr14**
Z	-4.515[b]	-2.843[b]	-1.804[b]	-6.899[b]	-.908[b]	-.143[b]	-.126[b]
Asymp. Sig. (2-tailed)	.000	.004	.071	.000	.364	.886	.900

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks
c. Based on positive ranks

the experiment may have caused a significant increase in using apps to teach and learn English (DS6), creating a blog in English (DS8) and creating and analysing surveys for the English class (DS11). However, no difference was noticed in some other cases such as navigating the web (DS1), using video games (DS12), using ICTs to help children with special needs (DS13) or using ICTs depending on the students' needs and context (DS14).

CONCLUSION

The main objectives of this research were to analyse the impact of using a PBL methodology on students' technological confidence and attitudes towards ICTs in the EFL classroom and to investigate their self-perceived digital competence and learning outcomes before and after the experiment. The findings revealed that pre-service teachers clearly show a positive attitude towards ICT integration in foreign language learning. Participants' technological beliefs scored higher at the end of the course, particularly those items associated with their interest in becoming more familiar with ICTs to help them learn and teach better in their future careers. However, they did not support the statement that the more technology you use, the higher respect you will get from your peers. Teaching candidates expressed their confidence in technology and their openness to learn about how to integrate different ICTs into the EFL classroom in a meaningful way.

In line with previous research (Bozologan & Ozen, 2014; Aprinyati et al., 2014), the PBL methodology used in the classroom seemed to engage learners in high-order thinking skills, particularly as it relates to creating, which was positively rated in the post-test, although students had initially privileged other low-thinking skills such as understanding in the pretest. In fact, participants showed their digital mastery and creativity but required some pedagogical assistance to integrate ICTs in terms of lesson planning, selection of digital materials and adaption to the target students. Students did not perceive analysing and evaluating as important thinking skills even after employing different tools to encourage and promote self- and peer-assessment in the classroom. Therefore, there is a need to strengthen certain critical skills among pre-service teachers (Røkenes & Krumsvik, 2016). In general, the adoption of a co-operative methodology based on PBL proved to be pedagogically enriching, as it motivated students and inspired them to share the results with other classmates.

In relation to self-perceived digital competence, the students' confidence in integrating digital tools increased at the end of the course, from an initially neutral position to self-reliance at the end. The learning gains were higher in those skills actively reinforced in the class, such as using different apps to teach and learn English, creating a blog or designing surveys in English. The results were similar in some items such as navigating the web or finding information, although participants lacked previous training about how to evaluate or rate the relevance of the on-line sources they used for their projects. Interestingly, the learning outcomes were lower than expected in some digital skills such as incorporating serious video games into the EFL classroom and using ICTs to help children with special needs. The first item about video games seemed to be less appealing as most students were not actively engaged in playing educational games for different reasons, they had not been previously trained in using educational video games and their personal experience was mostly based on commercial off-the-shelf video games, as they debated in the classroom. Similarly, students were unaware of the different apps and web-based programs available to help children with special needs (SEN) learn English since they always learned how to teach English in the mainstream classroom without seriously considering the need to adapt their lessons to the context and students' needs. In relation to both digital skills, using educational video games and web-based programs for SEN children, participants showed their concern over their lack of knowledge and demanded better training.

The use of ICTs in Education is on the rise, and technological advances are changing the teaching methodologies and the learning environment in second and foreign language learning. Traditionally, research has mainly focused on digital natives as current students and on their relation with technology in the classroom. However, the digital generation is already transitioning from digital native students to digital native teachers, and they demand better preparation in the meaningful integration of ICTs. Although the results

of this experiment may be limited to the context, the learning outcomes were positive regarding the sequential integration of ICTs into the EFL classroom using a PBL methodology. As future instructors, teaching candidates widely support the adoption of technology but demand better pre-service training for the adequate use of digital tools in their future professional careers.

FUTURE RESEARCH

The constant growth of ICTs and the transition of digital native students to digital native teachers will ensure an increasing presence of technology in the EFL classroom. Further research is needed on how to combine different digital skills from a pedagogical perspective and how to use technology to reinforce critical thinking among pre-service teachers. Particular attention should be given to the meaningful integration of some resources, such as the use of video games and web-based programs depending on the students' needs and context. Pre-service teachers show a positive attitude towards technology but more research is needed on the impact these digital tools may have on higher-order thinking skills and learning outcomes.

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